Spencer Mical

Team: S.T.S.

Teacher: Evandro

Mission: Chemical Neutralization

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| **Final design details.** This should include details of your final OSV design as well as your final mission strategy.  Include engineering drawings of the OSV and any components, as well as circuit diagrams as needed to make the description more comprehensible to a reader.  Include appropriate calculations and test results either in the body of the section or in an Appendix, as suited for narrative coherence.  Include the following subsections. |
| Structure. Present the size, shape, materials, and construction methods for your structure along with details of your wheel type and suspension. Include estimates or measurements of OSV mass.  Propulsion. Present the sizing and selection of your propulsion system.  Include details of wheel or tread size, motor selection, drive train, and steering system design.  Provide calculations for the required motor/wheel torque and resulting motor/wheel angular velocity and OSV speed.  Provide details of the placement of each of these components.  Provide results of performance measurements or tests conducted in the laboratories.  OSV Mission. Identify which mission your OSV attempted and describe your final strategy used to complete the mission.  Provide details of the performance of this design strategy.  Power. Present your power system for propulsion and electronic control systems. Describe how you modulated power.  Include battery selection details, run-time estimates and actual power subsystem performance.  Sensors and actuators. Present your sensors and actuators, describe how they interact with the Arduino interface, and discuss the rationale for their final placement on your craft.  Control algorithm. Discuss your control strategy and present a flowchart or pseudocode of your control algorithm.  In the Appendix, provide the final code generated for your controller.  These pages of final code are the only part of the Appendix that do not count towards your 25 page limit.  A reader should be able to make sense of how your algorithm functioned. |
| **Final design drawings.** Present the following computer-generated drawings with sufficient labels, dimensions and notes. Follow appropriate technical standards. All fonts must be 10 point or larger. Drawings that are appropriate to include within the ‘design details’ section, should be included there. Any that do not fit into the description should be included in this separate section. At the very least, the following three drawings should be included in the report:   * Drawing of OSV structure showing construction detail. * Assembly drawing of complete vehicle with all components.  Clearly identify the location of each component. * Wiring schematic(s) for all electronic components.   **Construction details.**  Provide the details of the construction materials and processes.  Include additional drawings and photos as necessary to allow someone with a similar level of training to regenerate your OSV. |

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Team S.T.S. O.S.V. was designed to meet the maximum parameters of the competition. In doing so, the O.S.V. was designed to have a wide body width and length. This design was purposeful, as it allowed the O.S.V. to drive over the chemical water source, stop on top of the objective, and lower a platform into the pool of water. The body of the O.S.V. has a square-section cut out of the middle, which enables the lifting platform to be lowered from the O.S.V. body to the water, and then raised back up from the water to the O.S.V. body. The lifting platform is attached to a C.A.D.-designed and printed mount/box, which provides support and stability for the lifting platform as it elevates and sinks. Also attached to the O.S.V. body are four motors, each secured to the O.S.V. body by C.A.D. modeled motor mounts. These motors provide power to the four wheels that propel our O.S.V., which are located on the underside of the vehicle.

Pertaining to the mission strategy, team S.T.S. used two ultrasonic sensors, which are mounted to the front of the vehicle. These, along with the control algorithm, enabled the O.S.V. to navigate from the landing zone to the polluted pool, while simultaneously avoiding obstacles. Upon arrival to the pool, the O.S.V. would park over the objective, and would then run a program which controls the crank that raises and lowers the lifting platform. The lifting platform will then be lowered into the water, where all of our base objectives will be met. After successfully navigating to the pool site, and thus accomplishing the first base objective, the lifting platform will then rise back up to the O.S.V. body. The platform will then lower again, and the pH meter will be inserted into the water. At this point, the pH meter will record the pH, satisfying the second basic objective. Upon determining the pH, the pH meter will inform the A.P.C. what the pH is, and then the A.P.C. will transmit the pH to command. After fulfilling the base objectives, additional instruments that are mounted on the O.S.V. body will perform the advanced objectives. There are two syringes attached to the O.S.V.’s body: a 10 mL syringe, which is used to extract a 10 mL sample of polluted water, prior to the team’s neutralization of the pool of water, and a 50 mL syringe, which has a tube attached to it. The 10 mL syringe is constrained by solenoid, which, upon a signal, will retract. Once the solenoid has moved back, the syringe will begin extracting the sample of water, and also completing the first advanced objective. Then, the 50 mL syringe is activated, as part of the second advanced objective of neutralizing the water source. The lifting platform will facilitate a base to be added to the acidic water, via a tube that connects a syringe that’s mounted on the O.S.V. body to the water source. A pump also housed on this platform would be activated, and would agitate the water as the base was dispensed, thus expediting the neutralization process, and accomplishing the second advanced objective.

Structure. Present the size, shape, materials, and construction methods for your structure along with details of your wheel type and suspension. Include estimates or measurements of OSV mass.

Team S.T.S.’s O.S.V. is a square, measuring 350 mm by 350 mm, with a body thickness of 6.13 mm. There is a square hole cut out of the center, as previously mentioned, which allows for the lifting platform to raise up and down.

The O.S.V. body is composed of wood. The majority of the other assembled parts that were subsequently attached to the O.S.V. are either wood, metal, or P.L.A. Wood was used to fasten and secure certain instruments down to the body of the vehicle. Metal was used as a wheel holder to ensure that the wheels are straight and secure, which ensures accuracy in the vehicle’s movement. P.L.A. was used as a result of C.A.D. 3D parts, which were constructed to meet certain parameters and dimensions, and then printed and added to the OSV body.

The O.S.V. weighs approximately 2700 grams without the base solution loaded into the syringe.

OSV Mission. Identify which mission your OSV attempted and describe your final strategy used to complete the mission.  Provide details of the performance of this design strategy.

Team S.T.S.’s mission was the chemical neutralization mission. The basic objectives were to navigate to within 250 mm of the polluted freshwater pool, much like the first basic objective of every other group, as we had to navigate to within 250 mm of our objective. Our second basic objective was to measure the pH level of the polluted freshwater pool, and our third basic objective was to transmit that pH level back to command. Our advanced objectives were to collect a 10-15 mL sample of the polluted freshwater source, prior to neutralizing the pool pH to a range of 6 - 8. We would then have to transmit this neutralized pH back to command to complete the second advanced objective.

In the first run, the O.S.V. completed all of the basic objectives. It navigated directly to the polluted freshwater pool after a brief interaction with a boulder. The O.S.V. then proceeded to park atop the polluted freshwater pool, per the group’s design. The lifting platform, containing a pH meter was lowered into the pool, where it acquired and transmitted the pH of the pool back to command. When the O.S.V. attempted to do the advanced objectives, a few things went wrong, and neither of the two were completed. Pertaining to the 10-15 mL sample, the O.S.V. had a syringe that had been stopped by a solenoid. When the solenoid fired, the syringe would retract, and would thus take up water with it. During the first run, the solenoid never fired, so the syringe never extracted water. Regarding the neutralization process, the O.S.V. was intended to administer a sodium bicarbonate base to the acidic pool. However, the base was added to the O.S.V. too early, and it solidified on the bottom of the syringe, thereby blocking any flow of water or base into the pool. All in all, the O.S.V. received a 60/60 for performing all of the basic objectives.

For the second run, things went much better. Again, the O.S.V. accomplished all of the basic objectives. It successfully navigated to the polluted freshwater pool, after temporarily getting stuck on a boulder. Through sheer power, the O.S.V. broke past, and went on to complete the mission. The O.S.V. stopped over the pool, and once again lowered the lifting platform into the water. The pH meter recorded and transmitted the pH of the acidic pool back to command, thus securing another perfect basic objective performance. However, the O.S.V. then went on to successfully complete the two advanced objectives as well. The solenoid fired properly this time, as an acceptable sample of water was collected (up to debate between the judges and our team). Additionally, the neutralization process went according to plan. The base was administered to the O.S.V. moments before the second run began, so it wouldn’t have time to settle and solidify. The syringe with base released a pre-measured amount of base and water into the pool, where the pH of the pool was neutralized from a pH of 2.99, to a pH of 6.31, thereby successfully completing the second advanced objective.